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ABSTRACT

A study at a small southwestern suburban school examined specific process variables which occurred as children were taught composition skills using word processing, word processing with voice synthesis, and no word processing. Subjects were 45 second grade students, who were divided into three groups on the basis of scores on a reading comprehension test; each group was made up of equal numbers of average, below average, and above average readers. One group was taught writing using beginning word processors and printers; the second group used word processors which utilized speech and printers; and the third group was taught without using word processing equipment. The curriculum emphasized composition strategies designed for young children, and all groups were given the same assignments. Completed compositions were linguistically analyzed for holistic quality, and the behavior of target subjects in each group was monitored. Data were analyzed in several areas: composition length; composition quality; invented spellings; peer interaction during writing; writing and editing; development of collaborative skills; influence of peer writers; developing a sense of audience; persistence when writing; and function of the voice synthesizer. Results indicated that children can benefit from careful instruction in composition in any of these settings, that they can master the rudiments of word processing with little training, and that word processing can free them from the difficulty of manuscript writing. (43 references) (MES)

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Process Variables in Writing Instruction Using Word Processing, Word Processing With Voice Synthesis and No Word Processing In Second Grade

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Objectives and Theoretical Framework

The use of computers in early childhood education is fairly widespread. However, the main use of computers in these early grades has been to teach early reading skills (alphabet names, phoneme-grapheme relationships, etc.) or beginning programming skills using Logo. Little research has been done using word processing to teach writing in these early grades. A few studies have found that the computer as a writing tool can facilitate the development of writing skills for children not yet capable of printing fluently by hand (Collins, 1984; Borgh & Dickson, 1986; Cameron, Linton, & Hunt, 1985).

Many researchers (Bean, 1983; Coburn, et.al., 1982; Daiute, 1983, 1985; Hennings, 1983; Moran, 1983; Piper, 1983; Schwartz, 1984; & Whithey, 1983) have cited the computer's value in aiding students' writing efforts by facilitating letter formations, reducing the frustration of recopying, by facilitating the reading of text during the various stages of the writing process, by producing neat, publishable copies from the computer's printer, and by making possible the reproduction of drafts of compositions for easy sharing with teachers and peers as the writing process unfolds.

Recent advances in technology have made it possible to add spoken feedback to word processors which may further facilitate the writing process. In their study Borgh & Dickson (1986) found that the addition of voice synthesis improved children's writing ability. In a study comparing the writing instruction in kindergarten and first grades using word processing, word processing with voice synthesis, and no word processing, Kurth & Kurth (1987) found that even very young students were able to use word processing to facilitate their writing.

Borgh & Dickson (1986) and Morocco (1986) have also cited the importance of process variables which occur when young writers use computer word processing. In their studies, these researchers discuss the collaborative writing strategies used by children; the editing strategies used by children both singly and in groups; the processes by which children planned their writing; the effect of the computer upon children's sense of audience; and other effects of the word processor upon children's writing. However, there has been little study of these process variables when young children write with computers.

Therefore, the purpose of this paper is to report the results of an examination of specific process variables which occurred as second grade children were taught composition skills using word processing, word processing with voice synthesis, and no word processing.

Procedures

Subjects

The Subjects were all the second graders attending a suburban Southwestern elementary school with an enrollment of 362 children. The school's reading achievement level was slightly below the mean reading scores in the district. The 49 second graders ranged in age from 6 years 10 months to 7 years 3 months on September 15th. Four students were not used in the study; one because of lack of parental permission; one because of a severe physical defect; and two because of special physical education classes. The remaining 45 students were divided into three groups of 15 students each on the basis of their Reading Comprehension subtest scores of the Metropolitan Achievement Test (1978). Because the research agreement with the Board of Education stipulated that no intelligence testing of the children could be done, no vocabulary or intelligence tests were used. However, Cameron et. al., (1987) found that reading skill emerged as the most reliable predictor of

writing skill, while oral measures of language skill did not correlate as highly with writing performance. Because of this finding, the grouping for writing instruction was based on reading comprehension scores.

From these three groups of above average, average, and below average readers, students were randomly selected and placed into three separate writing classes. Each writing class consisted of five above average, five average, and five below average readers. Because of the selection process, these groups cannot be presumed to be matched equally. Therefore, any between group comparisons must be made with extreme care.

Treatment

One group of children was taught writing using beginning word processors and printers. A second group of children was taught writing using word processors which utilized synthesized speech and printers. The third group of students was taught writing skills using no word processing equipment. However, they had access to a dry copy machine in order to share their stories. They also were allowed to make transparencies of their stories for sharing.

The equipment used for the two word processing groups consisted of 10 IBM Junior computers equipped with voice synthesizers. The Word Processing Program used in the word processing group was Word Perfect Junior (1984). The word processing program used in the word processing plus voice synthesis group was a modified version of the Talking Screen Text Writer by Rosegrant & Cooper (1983). This program was modified so that many close spellings and many non phonetic spellings of words were already in the program. This modification eliminated, except in a few instances, the need to use the "fix

speech" command which embeds the phonetic pronunciation of the word in the synthesizer program.

Before the actual writing classes were begun, the children in the two word processing groups received three sessions of 40 minutes each of keyboarding training. The children in the non word processing group were allowed to use computers to play games and to use the computers for math drill and practice sessions during this time. Although two different word processors were used, the children in each of the word processing groups were taught the same four basic word processing commands. After the keyboarding sessions, students were simply encouraged to copy a short story. When they made a mistake, the instructor showed them how to delete letters and words. When they finished the story they were taught a save command and a file name command. Thus all children using word processors were taught the correct keyboard finger positions, a name file command, a save file command, a delete, and a backspace command. They were also shown how to use the left and right arrows.

In addition, the children in the voice synthesizer group were taught the "talk" command. They could listen to their story at any time as they were writing it. However, they were not taught the command to have the voice synthesizer "read" the material aloud as they were typing. A pilot study had shown that this appeared to confuse young children as they were searching for letters. As soon as they had typed an entire word, they could signal the synthesizer to "read" the word for them. In the few instances in which the synthesizer did not read the word correctly, the instructors modified the embedded spelling so the synthesizer pronounced the word accurately.

All three groups were team taught by two teachers who had special interest and training in beginning writing instruction. These were not the regular teachers in the school. Each writing group met three times a week for 40 minutes each day for one semester. The instruction was given on Monday, Wednesday and Friday mornings from 8:30 to 10:30 for one semester.

The curriculum in all three classes emphasized composition strategies which were especially designed for young children. These sessions included pre-writing, writing, and revision instruction. Purposes for writing and audiences for writing were also discussed in all classes, and collaborative writing and editing groups were assigned in all three classes.

The writing assignments were the same for all three groups. The only difference between the work done by the three groups was that in the word processing group the children were instructed to write their stories on the word processor rather than on manuscript paper. The children in the word processing with voice synthesis group were told to write their stories using the word processor, and when they had finished they were told to listen to the synthesizer "read" the draft of the composition.

Each Subject was encouraged to complete 24 composition tasks during the semester. These tasks were specifically designed for young children and included reproducing fairy tales, scripted texts, narrative writing, dialogue writing, and expository writing exercises.

Students were encouraged to form collaborative writing and editing groups. At the beginning of the study each student in each group was assigned two partners (called "writing helpers"). Before a student could consider an assignment finished, his/her story had to have been approved by the "writing helpers." During the course of the instruction,

these writing groups were changed to only two students in order to encourage more collaborative writing.

Children were taught the terms writing and editing. They were taught that "writing" was finished when their story said what they wanted it to say. Editing was considered complete when the story could be read by others in their group.

Invented spelling was accepted as a legitimate way in which to write words. However, if a person in their "writing helper" group could not read the invented spelling, the children were instructed to ask the helpers or the teachers for the standard spelling. The major focus of the instruction, however, was on writing rather than on editing.

Collection of Data

Copies of all of the stories which the children considered finished were collected for the data analysis. Completed compositions from seven of the 24 assignments were selected to be used in the final analysis of compositions. The mean and standard deviation for composition length for each assignment and for all compositions was determined.

Each composition was also rated for holistic quality using the Systematic Analysis of Language Texts (SALT) by Miller & Chapman (1983). This software for linguistic analysis was used to determine: 1. the number of utterances (sentences); 2. the number of different words used in each composition; 3. the mean length of utterances (in words); 4. the mean length of utterances (in morphemes); 5. the number of different word roots; and 6. the type-token ratios. These indices were combined to yield a global rating of 1 - 6 for each composition. For instance, a child with a global score of 4 was above the median on four of the six indices. A child scoring 1 was above the median on zero or one of the indices, etc.

To collect much of the process data, six students in each group, two from each reading ability level, were selected as target Subjects. The two teachers and one observer carefully monitored the behaviors of these target students in each group. The time on task for each writing assignment, the pre writing discussions with the teacher, the revision and editing strategies used by children both singly and in groups, and the revision done by each targeted child in each group were noted. These target children were also asked specific questions regarding the processes they used when completing their assignments. Process questions such as "How do you know when your assignment is finished? " and "How do you know when you are ready to begin writing?" were asked of each target child.

Analysis of Data

Analysis of Composition Length

The comparison of composition length showed no significant difference between the three groups of children. The mean number of words used in the compositions was 32.8 for the non word processing group, 33.4 for the word processing with voice synthesis group, and 35.3 for the word processing group. Throughout the study, there was more within group variance than between group variance in composition length.

However, when composition length at the beginning of the semester was compared to composition length at the end of the semester, some interesting differences were noted for the above average and below average readers. When the difference between the mean length of the first five compositions and the mean length of the last five compositions written by above average readers was compared for all three groups, the two word processing groups showed a significantly greater gain in composition length. For the above average readers, the difference between the mean length of the first five compositions and

the last five compositions was 15 for the Word Processing Group, 14 for the word processing with voice synthesis group and 10 for the non word processing group. This difference would seem to indicate that as the good readers developed fluency with the computer keyboards, they wrote longer texts as the computer eased the difficulties associated with manuscript printing. In a similar manner, but to a lesser degree, the below average readers in the word processing groups made greater gains from the beginning of the semester to the end of the semester than did their counterparts in the non word processing group. For the below average readers, the difference between the mean length of the first and last five compositions was 8 for the word processing group, 7 for the word processing with voice synthesis, and 4 for the non word processing group. No difference was found between the three groups for the average readers. This finding would seem to indicate that for some students word processing can increase the quantity of writing completed.

Analysis of Composition Quality

Holistic ratings of composition quality using the SALT Analysis showed no significant difference in quality between each of the three groups. The mean holistic quality score for the word processing group was 5.1 (s.d. = .6); the mean holistic quality score for the word processing with voice synthesis group was 4.9 (s.d. = .5); and the mean holistic quality score for the non word processing group was 4.8 (s.d.= .7). The quality of the compositions was relatively high; the mean quality score for all compositions was 4.97. Careful instruction in pre writing and composing skills did help these children learn to write quality paragraphs for their developmental level. The SALT Analysis places a high value on elaboration and specificity in compositions. Because both the pre writing and

writing instruction helped children think about specific and concrete ideas and images, the compositions they wrote had relatively high SALT ratings.

Analysis of Invented Spellings

When the compositions were analyzed for spelling, there was a significant difference in the number of invented spellings used in the final drafts of each of the three groups. The mean number of invented spellings per composition was 5.1 (s.d. = 1.1) in the non word processing group; 4.2 (s.d. = .3) in the word processing group; and 3.1 (s.d. .2) in the word processing with voice synthesis group. Thus, the children who used word processors with word synthesizers used fewer invented spellings in their final drafts of compositions than students in either of the other two groups. This may have occurred because the voice synthesizer could not synthesize the word correctly if the spelling was not close to the phonetic pronunciation or to the preprogrammed spellings. If the computer could not synthesize the word correctly, the Subject may have been more likely to change the invented spelling to a more standard spelling.

Peer Interactions During Writing

Because one of the goals of the writing instruction was to help children understand that the purpose of writing is communication, sharing compositions with other children was encouraged. In order to facilitate this mutual sharing, writing helpers had been assigned in all three groups. Observers' notes indicate that the children in the word processing with voice synthesis group tended to have more interactions with other children regarding their compositions. Often children not assigned as a writing helper would listen to the stories being synthesized by the computer. As they listened, they often made specific suggestions for changing the story. Three children in the voice synthesis group made it a standard

practice to ask every child in the group to play his/her composition for them during every session.

This type of mutual sharing occurred also in the word processing alone group as children went from computer screen to computer screen and read each other's texts. Again as they read the stories from the computer screen, they gave advice as to how the story could be changed.

Although children were encouraged to read each other's texts in all three groups, this shared reading did not happen nearly as often in the non word processing group. Even though children were allowed to make copies of their stories on the dry copy machine and were also allowed to make transparencies of their stories for viewing; there was considerably less sharing of stories in the non word processing group. Part of the reason for this lack of sharing appeared to come from the difficulty that children had with reading the manuscript printing of their classmates. When the children made corrections on the printed manuscripts, they often simply crossed out mistakes and wrote on top or crowded in letters, rather than rewrite the page. This resulted in manuscripts which were often difficult for the other children to read. It was also observed that the manuscripts of two children who wrote in a large and legible print were read more often than any other manuscripts, even though these two children had only average writing ability. Thus the ability of the computer to produce uniform and easily read letters on the screen and on paper made an important contribution to the sharing of compositions from writer to writer. The attraction of the computer screen, the novelty of the voice synthesizer, and the legibility of printer copies all seem to foster collaboration when writing with word processors.

Writing and Editing

A major focus of the writing instruction was to help children think about the ideas they were writing about. The ease with which finished copies, multiple copies, and revisions of compositions can be made was an important incentive for group interactions in the word processing groups. However children in all three groups were very eager to edit the material for mechanical errors rather than for meaning ambiguity. Unless they were repeatedly reminded that they needed to think about the meaning of the composition, children simply modeled what they had seen many of their teachers do and focused on correcting spelling and punctuation in each other's work. Many children, especially the more able readers, were very insistent on capitol letters and periods. Often, as other research has indicated they would, they over punctuated to a remarkable degree.

The Development of Collaborative Skills

Because the aim of the writing instruction was to encourage collaboration, some of the writing assignments were given to pairs of students rather than to a single student. Good readers seemed to be able to collaborate more readily than poor readers. When two good readers were paired, their compositions tended to be longer, more sophisticated, and more specific, (as measured by the SALT) than other pairs. Good readers paired with poor readers generally produced high quality compositions; while poor readers paired together produced the lowest quality compositions. In this regard our results parallel those found by Cameron et. al, (1985) who found that matched reader pairs, either good or poor, conformed to their performance level as would be expected. Mixed pairs, that is a good reader with a poor reader, tended to participate at the higher level in most instances.

In this study, a high degree of meaningful collaboration was achieved by the majority of good readers. These good readers seemed to be able to collaborate when writing and enjoyed the process. In these instances, these more capable readers were very satisfied with sharing the story and the author line, and true collaborative authorship did occur.

In those instances when an above average reader was paired with a below average reader, the composition quality remained high; however, the below average reader generally made few suggestions, and many of these suggestions were ignored. When a below average reader was paired with an above average reader, the above average reader almost always controlled the computer keyboard. When this same pairing was used in the non word processing group, generally the better reader wrote the story. However in a few instances, the below average reader took his/her own paper and began writing some ideas on his/her own paper. This never happened when the pairs were seated before one computer. As stated before, if one is interested only in the quality of the product, then collaboration between above average readers and below average readers produces high quality compositions. However, careful observations of these dyads of good and poor readers seems to indicate that the product is improved at the expense of the poorer reader. The best products from below average readers were obtained when the instructors worked with small groups of below average readers and prompted them to include more specific details and greater time and place accuracy. After several of these sessions, improvement was seen in the compositions of the poorer readers. Little improvement was seen when poor readers worked with good readers.

Influence of Peer Writers

The influence of peer writers varied greatly from group to group and from child to child. When one target child was asked how she knew she was ready to begin to write a narrative story, she replied "I am ready to write when I know the ending to the story. If I can't end it--if it isn't ended, then I can't start it." This child showed little tendency to rewrite the basic plot of the story to accommodate the suggestions of others--her story line generally remained the same, even when another child suggested a different ending or event.

Another good reader however was more easily influenced by his peers while writing. He explained that he knew he was ready to write a narrative when he knew who was in the story. Then he added, "then when I write I figure out what is going to happen to them." His story lines were very much influenced by suggestions from the peer group surrounding him.

Another facet of the writing instruction dealt with helping children deal with the change from the immediate known environment of restrictive prose to the need for describing environment in written elaborative prose (Halliday & Hassan, 1976; Halliday, 1975; Holdaway, 1979). Peer collaborators were very adept at helping children remember to add the necessary phrases which would indicate setting, place, person speaking, time, etc., which are necessary in elaborative prose. For these details, especially, above average readers were able to give constructive help to less able readers.

Developing A Sense of Audience

During the semester, the concept of audience in writing was introduced to all three groups. The large amount of sharing of written work which occurred in both word

processing groups helped children gain a sense of audience. Exercises to help children learn this concept were included in several writing sessions. Observers noted that during some of the collaborative writing attempts, children with stronger personalities or language skills seemed to "take over" the stories of children with weaker skills. When the concept of audience was introduced to them, some of the weaker writers seemed more able to claim ownership of their stories even when matched with a stronger student. One observer noted a below average male writer who turned to his very controlling, more skilled, female partner, and said, "It's my story--you're audience. When you understand my words, you can help me fix them better."

Persistence when Writing

Children were generally well motivated during the sessions and because of the high teacher/pupil ratio were usually attentive and working on task. For the most part, the targeted students from each group spent forty minutes each day working on their assignments.

Because all of the assignments were preceded with careful pre-writing instruction and discussion, children came to the writing task class primed with ideas. In all groups, children's ideas and production wishes (what they wanted to say) always far out distanced their ability or patience to actually produce the words and sentences on the computer screen or on paper. However, near the end of the study, the children in the computer groups seemed to be able to write more of their ideas before running out of energy or patience. This seemed especially true when one observed the below average readers in the three groups.

The Function of the Voice Synthesizer

At the beginning of the experiment, when the children were just beginning second grade and the word processors and synthesizers were novel, all children in the word processing with voice synthesis group spent great amounts of the session time listening as the computer "read" their compositions. Because they spent so much time listening, they had less time to write than the other two groups.

However, the observers noted that as the semester progressed, the better readers in the word processing with synthesis group listened to their stories less often than the poorer readers. One good reader commented, "I can read the story much faster than the computer, so I'll read it myself." This tendency of the good readers to make less use of the voice synthesizer as the semester progressed might have given them more time to write, and their compositions became longer. This finding was confirmed when the compositions written by the five best readers in the two word processing groups were compared for length, and there was no significant difference in composition length. When the compositions written by the five best readers in all three groups were compared for length, the compositions written by the non word processing group were significantly shorter.

However, the poor readers in the word processing with voice synthesis group continued to use the synthesizer to "read" their stories as often at the end of the semester as they had at the beginning. For these less skilled readers, the reinforcement which they received from listening to and checking their stories with the synthesizer seemed important. In a previous study with slightly younger children (Kurth & Kurth, 1987), the teachers felt that the use of the voice synthesizer added an important dimension to the

writing instruction. The teachers felt that the feedback the children received from hearing their stories reinforced valuable reading skills and helped children maintain a greater sense of audience. The results of the present study suggest that the voice synthesizer might be most valuable when used with beginning writers or poor or average readers. As children become skilled readers and writers, the voice synthesizers may become less helpful.

Summary

The results of this study indicate that very young children can benefit from careful instruction in composition with or without word processing and word processing with voice synthesis. However, the results also show that it is possible for very young children to master the rudiments of word processing with little special training. After mastery, the word processor appears to free them from the difficulty of manuscript writing. Therefore, word processing, and word processing with voice synthesis combined with effective instruction in writing, does appear to be a tool of promise for even very young children as they begin to write. However, it needs to be emphasized that only a combination of high quality writing instruction along with word processing can result in improved writing. This study does not support the idea that working with word processing will automatically increase the quantity and quality of student compositions. The use of word processing can only enhance the teaching of written composition. The most important ingredient in any composition program is a teacher who is knowledgeable about the composing processes.

Special attention must also be paid to the process variables which interact when students are learning to write. In this study several process variables were identified which appeared to affect the way in which children learn to write. Collaborative writing and peer editing affect children of differing abilities and personalities in different ways.

Care must be taken when forming peer groups for writing collaboration in order to ensure that all children will benefit from the instruction.

The results of this study again reaffirmed the motivational value of writing with computers for young children. These results also seem to suggest that the use of word processing with voice synthesis might be most suitable for beginning writers or for low ability readers as they begin to write.

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